

The effect of internal structure on the scattering properties of agglomerated debris particles

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The discrete dipole approximation (DDA) has been used in many works to investigate the light scattering properties of both arbitrarily shaped and compositionally heterogeneous particles (e.g., [1,2]). These types of particles have many applications to remote sensing and telescopic observations. It is clear that highly irregular particles are a much better match to experimentally measured Muller matrix elements of real mineral dust than spheres or spheroids, despite the very different morphologies that individual dust particles can exhibit [2]. However, there is still much work to be done to understand whether and how internal structure affects the light scattering response of both multi-component and large, homogeneous particles.

Preliminary work has been done on the accuracy of effective medium theory (EMT) approximations for calculating the scattering properties, including the total-intensity phase function and the linear polarization response, of particles with heterogeneous composition [3]. Here we look at whether changing the monomer size of the agglomerates has an impact on the accuracy of EMT approximations for heterogeneous particles. We also look at the accuracy of EMT for multi-component particles, rather than the two-component mixtures that have been previously studied.

There have also been studies on the effects of particle internal structure on the light scattering phase matrix [4] and the effect of monomer shape on backscattering response [5]. These works found that monomer shape does affect the light scattering response and increasing the size parameter can enhance the negative polarization branch, but did not extend these results beyond a size parameter of $x = 20$. We examine the effect of changing the internal monomer size for a highly absorbing ($m = 2.43 + i0.59$), large size parameter particle ($x = 48$).

References

- [1] Draine, B. T., and P. J. Flatau, 1994: Discrete dipole approximation for scattering calculations. *J. Opt. Soc. Am. A* **11**, 1491–1499.
- [2] Zubko, E., K. Muinonen, O. Muñoz, *et al.*, 2013: Light scattering by feldspar particles: comparison of model agglomerate debris particles with laboratory samples. *J. Quant. Spectrosc. Radiat. Transfer* **131**, 175–187.
- [3] Videen, G., E. Zubko, W. Sun, *et al.*, 2015: Mixing rules and morphology dependence of the scatterer. *J. Quant. Spectrosc. Radiat. Transfer* **150**, 68–75.
- [4] Zubko, E., D. Petrov, Yu. Shkuratov, and G. Videen, 2005: Discrete dipole approximation simulations of particles with hierarchical structure. *Appl. Opt.* **44**, 6479–6485.
- [5] Zubko, E., A. Ovcharenko, S. Bondarenko, *et al.*, 2004: Backscattering of agglomerate particles. *Proc. SPIE* **5617**, 407–415.

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